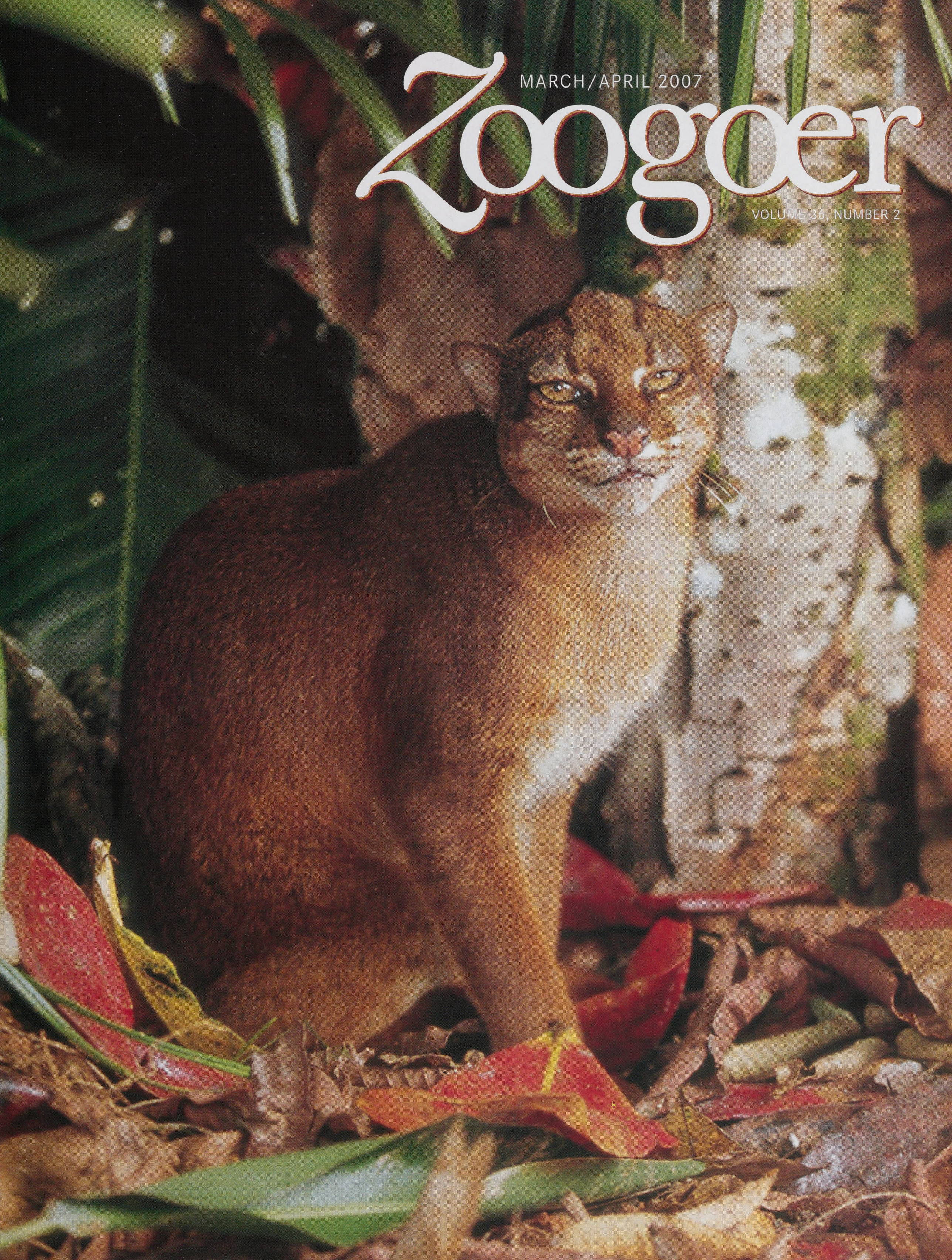
MARCH/APRIL 2007

Zoogoer

VOLUME 36, NUMBER 2



REFRESHING
Coke
S H A R E

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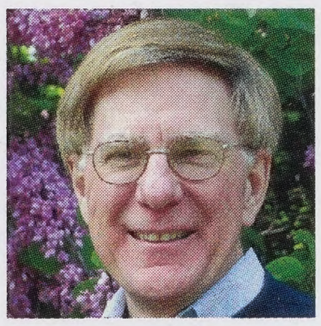
Invaluable Volunteers



Late last summer, just a few weeks after I joined FONZ as its new Executive Director, I attended our annual volunteer appreciation picnic. I'd been briefed about the enormous assistance volunteers give to FONZ and the Smithsonian's National Zoo. This was my first chance to meet and thank many of these dedicated individuals.

By the next time I had a chance to thank volunteers—during a winter holiday party—my admiration had turned to awe. It's one thing to be told about how important our volunteers are. It's quite another to see, as I have since then, the difference our volunteers make every day in everything we do. A mere "thanks" seemed inadequate to recognize their contributions. But I'd also learned that these selfless individuals want nothing in return for their efforts. Their reward is the satisfaction of helping us connect people to wildlife.

To give you some perspective on the importance of volunteers, some 1,500 volunteers provided more than 90,000 hours of service in 2006. That's equivalent to nearly 45 people working full-time, effectively increasing the size of the FONZ permanent staff by nearly 50 percent! Volunteers are essential members of our Zoo/FONZ team. They are the front-line educators who conduct exhibit interpretation. They are research assistants who collect data for our scientists. They help keepers and gardeners with their daily chores. They do all manner of tasks for our special events. And more.

How volunteers contribute is as varied as the volunteers themselves. One woman has been volunteering since 1973—almost 35 years! She has served as a Zoo guide, office assistant, Small Mammal House interpreter, Zoo on Wheels coordinator, behavior watcher, and, at present, animal records keeper in the Small Mammal House.

A retired couple drive 50 miles from Fredericksburg, Virginia, every Tuesday to ensure Web visitors can see our giant pandas on the panda cams. They conduct golden lion tamarin and sloth bear behavior watches, too. We also enjoy the support of some real specialists: One young woman has volunteered once a year for the past five years for the arduous task of hanging more than 100 signs identifying our restaurant partners at each ZooFari. Another volunteer has copyedited every issue of *ZooGoer* since 1988.

There are many, many more examples I could cite, but I must mention the 30 volunteers who form the FONZ Board of Directors and Advisory Board. These individuals step up from the FONZ membership to take leadership roles in our organization and set FONZ's goals. Board members offer advice and assistance based on their diverse skills, which range from the law and business to education and marketing. They keep us in touch with you and our local community. Right now, the Board, led by President Robyn Kravit, is working on an exciting new strategic plan for FONZ that I will share with you very soon.

Volunteers are the heart and soul of FONZ and are vital to the National Zoo becoming the world's finest zoo and FONZ the finest partner organization. I hope you will consider joining our volunteer corps so we can together make a difference to the future of wildlife and the natural world. For more information, see **www.fonz.org/volunteer.htm** or call 202.633.3025. We look forward to hearing from you.

Sincerely,

Bob Lamb

Bob Lamb
Executive Director, Friends of the National Zoo

FONZ Friends of the National Zoo is a nonprofit organization dedicated to supporting the conservation, education, and research efforts of the Smithsonian's National Zoo. Formed in 1958, FONZ was one of the first conservation organizations in the nation's capital. Friends of the National Zoo is dedicated to supporting the National Zoo in a joint mission to study, celebrate, and protect the diversity of animals and their habitats.

ZooGoer [ISSN 0163-416X] is published bimonthly by Friends of the National Zoo (offices located at the Smithsonian's National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537) to promote its aims and programs, and to provide information about FONZ activities to its members, volunteers, and others interested in the purposes of FONZ. Periodicals postage paid at Washington, D.C. Postmaster: Send change of address to *ZooGoer*, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537. Copyright ©2007. All rights reserved.

Smithsonian **National Zoological Park** is located at 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From October 29, 2006, to March 10, 2007, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m. From March 11, 2007, to November 4, 2007, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m.

Membership in FONZ offers many benefits: programs, publications, discounts on shopping and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537, call 202.633.3034, or go to www.fonz.org/join.htm.

Membership categories and annual tax-deductible dues are:

Household	$55
Young Professional	$40
Individual	$40
Senior	$35
Contributing	$100
Sustaining	$150
Patron	$250
Sponsor	$500
Benefactor	$1000
Director's Circle	$2500
ZooGoer (for those outside a 200-mile radius of Washington, D.C.)	$30

($8 of membership dues goes to a *ZooGoer* subscription)

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An audio version of *ZooGoer* is available on our website, for members who cannot read standard print due to disability. For more information, please visit **www.fonz.org/zoogoer.htm.**

On the cover: Little is known about the bay cat (*Catopuma badia*) and many other small-cat species. Photo by Art Wolfe/www.artwolfe.com.

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ASSOCIATION OF ZOOS & AQUARIUMS

The Smithsonian's National Zoo is accredited by the Association of Zoos and Aquariums.

A Trip to Panda Heaven

On December 7, I enjoyed the afternoon of a lifetime. I was at China's famed Wolong Giant Panda Breeding Center, where more than 70 giant pandas live, 18 of them cubs born there in the last year. And I got to hold one of these cubs as our Zoo delegation lined up with our Chinese colleagues for a remarkable photo shoot. Here was proof that passion, commitment, determination, and cooperation can succeed against all odds in saving a species from extinction. I was beaming with pride because the Smithsonian's National Zoo helped to make what I called "the miracle at Wolong" possible.

I was on my first-ever visit to China, accompanied by Robyn Kravit, President of the Board of Friends of the National Zoo; David Wildt, head of the Zoo's Center for Species Survival; and Mabel Lam, our advisor and interpreter. My purpose was to meet with our Chinese partners, discuss future collaborations, and gain a better understanding of the challenges and advances in panda conservation programs. I also wanted to see for myself the spectacular wild places that giant pandas call home.

At Wolong and later at the Chengdu Breeding Base for Giant Pandas, which experienced its own baby boom in 2006 (I was able to hold twin cubs there!), I saw the fruits of our scientists' collaboration with Chinese colleagues to improve the health and reproduction of giant pandas, including pioneering techniques for artificial insemination. This has proven so successful that 221 pandas now live in zoos in China and around the world, a population well on its way to being self-sustaining with a target number of 300. As a result, we talked extensively about how to cooperate in preparing to reintroduce pandas to protected areas where their numbers are low.

A baby boom of giant pandas at Wolong.

But there is good news on the wild front, too, where an estimated 1,600 pandas live. The number of parks and reserves in giant panda habitat has risen to 59, and more than half of all remaining habitat is now protected. Visiting the Tangjiahe and Wanglang nature reserves, I saw very well-managed areas with dedicated, passionate staff working with local communities to protect pandas and the reserve. Tangjiahe has been the site of many of our capacity-building programs in China. Since 2001, our scientists have helped train more than 300 staff members from 20 different reserves—and these people are now training others!

Also in Tangjiahe, reserve staff along with our Zoo scientists have surveyed the park's wildlife through camera-trapping—discovering, among other things, that clouded leopards live there—and are studying takin, a protected species in China, and black bears to learn more about their ecology and behavior. We are collaborating on a project to monitor animals and plants in the Wanglang reserve as well.

After this informative, fascinating trip amid wild places even more spectacular than I'd imagined, I came home buoyed with hope. Chinese conservationists and their colleagues from our and other North American zoos and from international organizations such as the World Wildlife Fund are succeeding in turning giant pandas off the road to extinction and onto the road to recovery. This is accomplished with a winning combination of good science conducted in zoos and breeding centers and in the wild, careful conservation planning, education and inspiration of people, the support of people like you, and plain old hard work.

Years ago, critics objected to giant pandas in zoos, saying it was not worthwhile. History and the results discussed above have proven them wrong. Today, our precious panda Tai Shan has raised awareness among people around the world. Our scientists continue to learn ever more about pandas. Our cooperative programs and financial support for panda conservation in breeding centers and in the wild in China are making a real difference there. The future for pandas is bright as a result.

In fact, giant pandas are not the only such example. The future is also brighter for golden lion tamarins, black-footed ferrets, scimitar-horned oryx, Guam rails, and many other species thanks to our work and that of other cooperating zoos and organizations, using the same winning combination of tools as for giant pandas. And with our Elephant Trails project, we are demonstrating our commitment to saving Asian elephants in zoos and in the wild the same way. Critics say elephants shouldn't be in zoos. I say they must if we are to ensure their future. I look forward to your continued support.

Sincerely,

John Berry

John Berry
Director, Smithsonian's National Zoological Park

See photos and learn more about John Berry's China trip at **www.fonz.org/giantpandas.htm.**

Jessie Cohen/NZP

Male gorilla Baraka has returned to his birthplace, the Great Ape House at the Smithsonian's National Zoo, after a two-year stay in Nebraska.

Animal News

A familiar face has returned to the Great Ape House at the Smithsonian's National Zoo—Baraka, a male **western lowland gorilla** (*Gorilla gorilla gorilla*) born here in 1992. Baraka went to the Henry Doorly Zoo in Omaha, Nebraska, in 2004 and came back to the National Zoo in December 2006.

In their native habitat in Africa, western lowland gorillas live in groups of up to 50 members led by at least one dominant adult male, or silverback. Zoo staff are reintroducing Baraka to the Great Ape House's group, which is composed of his mother Haloko; half-sister Kigali; Mandara, a female that was found holding him several hours after he was born and adopted and raised him from infancy; and two of Mandara's young male offspring, Kojo and Kwame.

Jessie Cohen/NZP

Spectacled bear Nikki is new to the Zoo.

In Beaver Valley, two special **Mexican wolf** (*Canis lupus baileyi*) sisters went on exhibit in January. Catella and Nieta de Niña were born into the first-ever litter of Mexican wolves successfully conceived by artificial insemination. They are one year old and will be nonbreeding companions for Cheveya, an eight-year-old male that arrived at the Zoo in 2001 with his brothers Tika and Lakota. Cheveya's brothers were recently sent to other zoos based on the recommendations of the Association of Zoos and Aquariums' Species Survival Plan for Mexican wolves.

A new male **spectacled bear** (*Tremarctos ornatus*) first explored his outdoor exhibit near Amazonia in January. Fifteen-year-old Nikki came to the Zoo in December from the Beardsley Zoo in Bridgeport, Connecticut. When he is outdoors, he will be able to see the Zoo's 30-year-old female spectacled bear, Bandit, in a nearby enclosure. Spectacled bears are native to the Andes and outlying ranges from western Venezuela to Bolivia. They are named for the whitish, ring-like markings around their eyes that resemble spectacles. Except during breeding season, they live alone.

Events

For more information on upcoming events at the Zoo, visit **www.fonz.org/events.htm**.

North American Wildlife Celebration

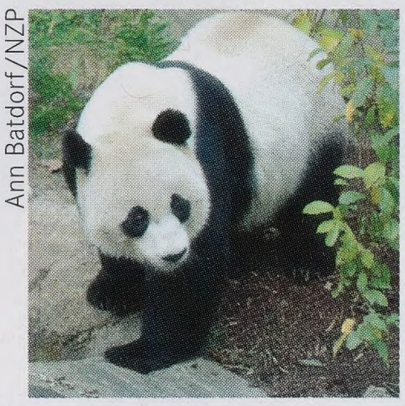
March 17–10 a.m. to 4 p.m.

At this free event, visit the Zoo's North American animals–including Mexican wolves and California sea lions–and learn what's being done to conserve wildlife locally and throughout the continent.

Giant Panda Month

April 1 to 30

Join our month-long celebration of the Zoo's giant pandas. For information on special activities, visit **www.fonz.org/giantpandas.htm**.



Ann Batdorf/NZP

African American Family Celebration

April 9–10 a.m. to 4 p.m.

Washington-area families have come together at the Zoo on the day after Easter for more than 100 years. FONZ invites you to continue the tradition with a day of free multicultural and holiday activities for all ages.

Bird Fest

April 28 and 29–10 a.m. to 4 p.m.

The Zoo celebrates International Migratory Bird Day with free activities and theatrical performances. Learn about migratory birds and efforts to protect them. Winning entries for the U.S. Fish & Wildlife Service's National Junior Duck Stamp Art Contest will be on display in the Visitor Center.

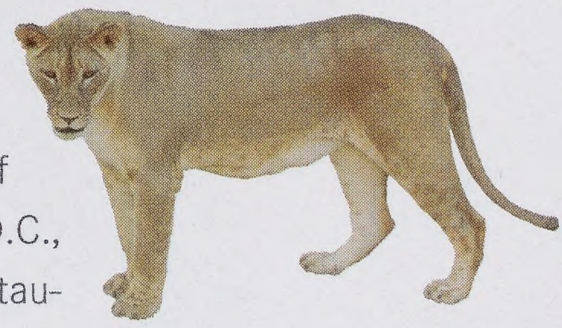
Guppy Gala

May 11–6 to 8:30 p.m.

FONZ's wild party for kids ages two to 12 and their families has arts and crafts, live entertainment, delicious treats, and fun activities. Proceeds support the Zoo's public education programs. Tickets sold beginning March 1 at **www.fonz.org/guppy.htm**.

National ZooFari: Savanna Soiree

May 17–6:30 to 10 p.m.



Mehgan Murphy/NZP

FONZ's annual epicurean extravaganza features more than 100 of the Washington, D.C., area's finest restaurants, and vintners from around the country. Gourmet food, fine wines, and fabulous entertainment make ZooFari the talk of the town. This year's theme, "Savanna Soiree," celebrates the Zoo's African species and Zoo scientists' work with African wildlife. Proceeds fund a variety of Zoo initiatives. Tickets sold beginning March 1 at **www.fonz.org/zoofari.htm**.

Lectures

Lectures are free and open to the public. For more information and to RSVP, visit **www.fonz.org/lectures.htm.**

Rare Bird

March 15–Film screening 7 p.m.

In cooperation with the D.C. Environmental Film Festival, we present the U.S. premier of *Rare Bird*, a true story of hope, inspiration, and commitment. A 15-year-old boy helps find the cahow, a bird believed to be extinct for more than 300 years that is threatened by man-made development, invasive species, and the threat of global warming. What can be done to save it from oblivion?

Thunderbeast

March 22–Film screening 7 p.m.

This film, directed by Emmy Award-winning wildlife filmmaker Bob Landis, is a stunning insider's view of American buffalo in Yellowstone National Park, from epic battles with grizzly bears and wolves to treacherous winters and late-summer mating seasons. Screened in cooperation with the D.C. Environmental Film Festival. A discussion with coproducer Kathryn Pasternak and John Seidensticker, head of the Species Conservation Center at the Zoo, will follow the screening.

New Zealand's Eccentric Icon: The World's Most Unusual Bird

March 28–Book signing 7 p.m., lecture 7:30 p.m.

New Zealand writer Neville Peat will talk about kiwis and sign copies of his new book, *Kiwi: The People's Bird.*

Condor: To the Brink and Back

April 5–Book signing 7 p.m., lecture 7:30 p.m.

John Nielsen, an award-winning correspondent on the science desk at National Public Radio, signs copies of his book and talks about the amazing zoo conservation success story of the California condor.

The Maya Tropical Forest

April 19–Book signing 7 p.m., lecture 7:30 p.m.

James Nations, director of the Center for State of the Parks at the National Parks Conservation Association, signs his book and talks about the people, history, and wildlife of the lowland tropical forests of southern Mexico, Guatemala, and Belize.

J. & K. Hollingsworth/USFWS

Songbird Journeys

May 3–Book signing 7 p.m., lecture 7:30 p.m.

As part of the Zoo's celebration of International Migratory Bird Day, Miyoko Chu, ornithologist and staff writer at the Cornell Lab of Ornithology, signs copies of her book and talks about the scientific quest to answer age-old questions about songbirds.

Captain Meriwether Lewis (1774–1809) and William Clark (1770–1838) on their transcontinental expedition from the Missouri to the Pacific Ocean in 1804–06 (oil on canvas), Burnham, Thomas Mickell (1818–66)/Private Collection/The Bridgeman Art Library

Meriwether Lewis and William Clark documented the plants, animals, landscapes, and people they encountered on their expedition to the Pacific Ocean. Their journals are helping scientists understand how the ecology of the American West has changed since the early 19th century.

Past AS PROLOGUE

BY MARY-RUSSELL ROBERSON

Ecology is the science of describing how plants and animals in a particular place interact with each other and their environment. Over time, the ecology of any place changes, and it's important to understand where the present lies on a continuum of change: Is the population of one species rising while another is falling? Is the plant community different than it was years ago? Have new species moved in?

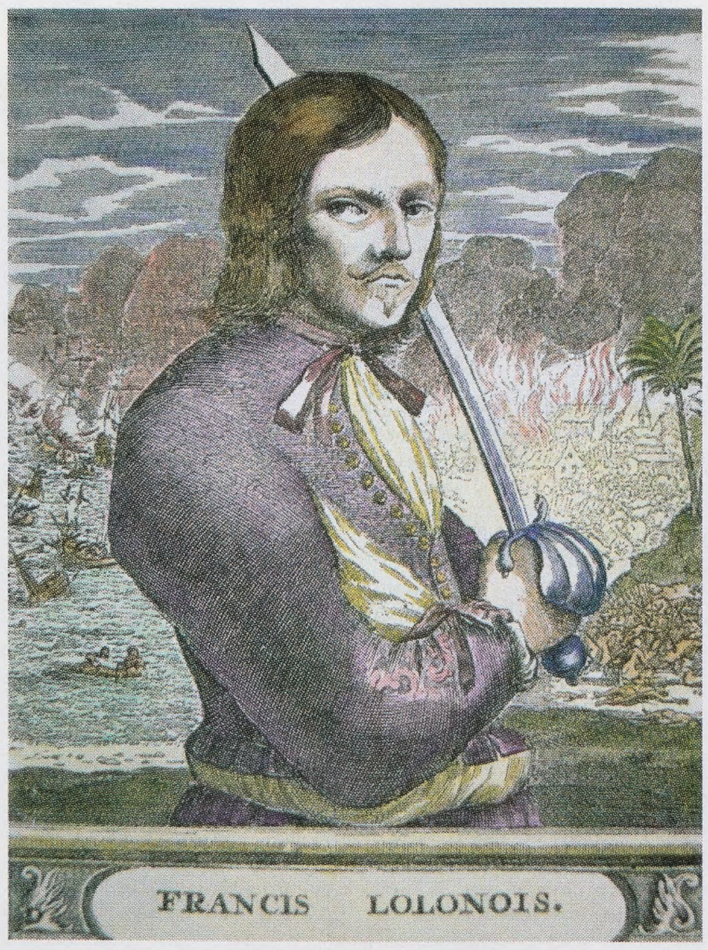
Ecologists have often used their own lifetimes as a measure, comparing the current character of the woods or size of bird flocks to what they remember from childhood. But now, some are looking back further and, if possible, trying to quantify what they find. This relatively new field is called historical ecology.

To piece together an ecology that existed before they were born, the pioneers of this field are using many of the same sources as historians, including journals, maps, and other written records, as well as oral history accounts. For example, scientists and historians are using such diverse sources as the journals of 17th-century pirates and centuries-old European cookbooks to chart the rise and fall of various marine species.

At the University of Kentucky's Department of Forestry, scientists John Cox, David Maehr, and Jeffery Larkin wondered whether towns, creeks, and mountains named after animals could provide clues to the animals' ranges when the United States was being settled by Europeans. They used the Geographical Names Information System database maintained by the U. S. Geological Survey to map the occurrence and frequency of places named for any of 24 species—21 mammals, two reptiles (alligator and rattlesnake), and one bird (passenger pigeon).

Seven of these animals, including bear and deer, had names often applied to several different species, and were excluded from the results. For the remaining 17 species, the overlap between the animals' historical ranges and the distribution of places named for them was between 21 and 100 percent, with a mean of 83 percent. Javelina place names were most reliable with a 100 percent overlap—Javelina Canyon in Terrell County, Texas, is one example—most likely because their distribution was relatively small. Coyote had a 99 percent overlap, perhaps for the opposite reason: because they were so ubiquitous. Among the least reliable were place names containing the word "lynx": These overlapped with lynxes' historical ranges just 49 percent, perhaps because lynx were often confused with bobcats or because these cats are so secretive.

In a paper published in the journal *Conservation Biology* in 2002, the scientists concluded that place names in the United States do illustrate a drastic reduction in the ranges of most of these animals over the past few centuries. But although place names, pirate journals, and cookbooks can provide supporting evidence or highlight areas for further research, they cannot be relied upon in isolation. Wolverine, Kentucky, for example, is named for the Wolverine Coal Company, and not all Bear Lakes were necessarily frequented by bears.



Francis Lolonois, 1684 (colored engraving)/Peter Newark Historical Pictures, Private Collection/The Bridgeman Art Library

Journals of 17th-century pirates describe marine ecology of long ago.

When evaluating any source material, historical ecologists consider the fallibility of human memory and motivation. For example, several early European explorers to the Americas embellished their accounts with tales of oversize aggressive women warriors called Amazons. They may have been trying to impress others or sell more books, or perhaps it was just wishful thinking. To mine historical evidence for more accurate information, historical ecologists always look for ways to corroborate data.

The Lewis and Clark Journals

The earliest and most detailed account of the natural history of the American West was provided by the Lewis and Clark expedition. Meriwether Lewis, along with William Clark and the other members of the Corps of Discovery, were charged by President Thomas Jefferson to follow the Missouri River west from St. Louis in search of a good overland route to the Pacific Ocean. Jefferson also instructed the group to document "the names of the nations & their numbers;... the soil & face of the country, it's [sic] growth & vegetable productions, the animals of the country generally, & especially those not known in the U.S."

The explorers left St. Louis in May of 1804, reached the Pacific in the fall of 1805, and returned to St. Louis in September of 1806, crossing rugged and unmapped ground that had not been systematically explored by European Americans. As directed by Jefferson, the Corps kept copious notes of its travels, describing in astounding detail just about everything it saw and counting and measuring whatever it could.

In his journal entry dated February 17, 1806, Meriwether Lewis sketched this illustration of a "head of a vulture"—a California condor (*Gymnops californianus*).

American Philosophical Society

On Saturday, May 4, 1805, while camped in present-day Roosevelt County, Montana, Meriwether Lewis wrote,

> *I saw immence quantities of buffaloe in every direction, also some Elk deer and goats [pronghorn]; having an abundance of meat on hand I passed them without firing on them; they are extreemly gentle the bull buffaloe particularly will scarcely give way to you. . . . we saw many beaver some which the party shot, we also killed two deer today. much sign of the brown bear.*

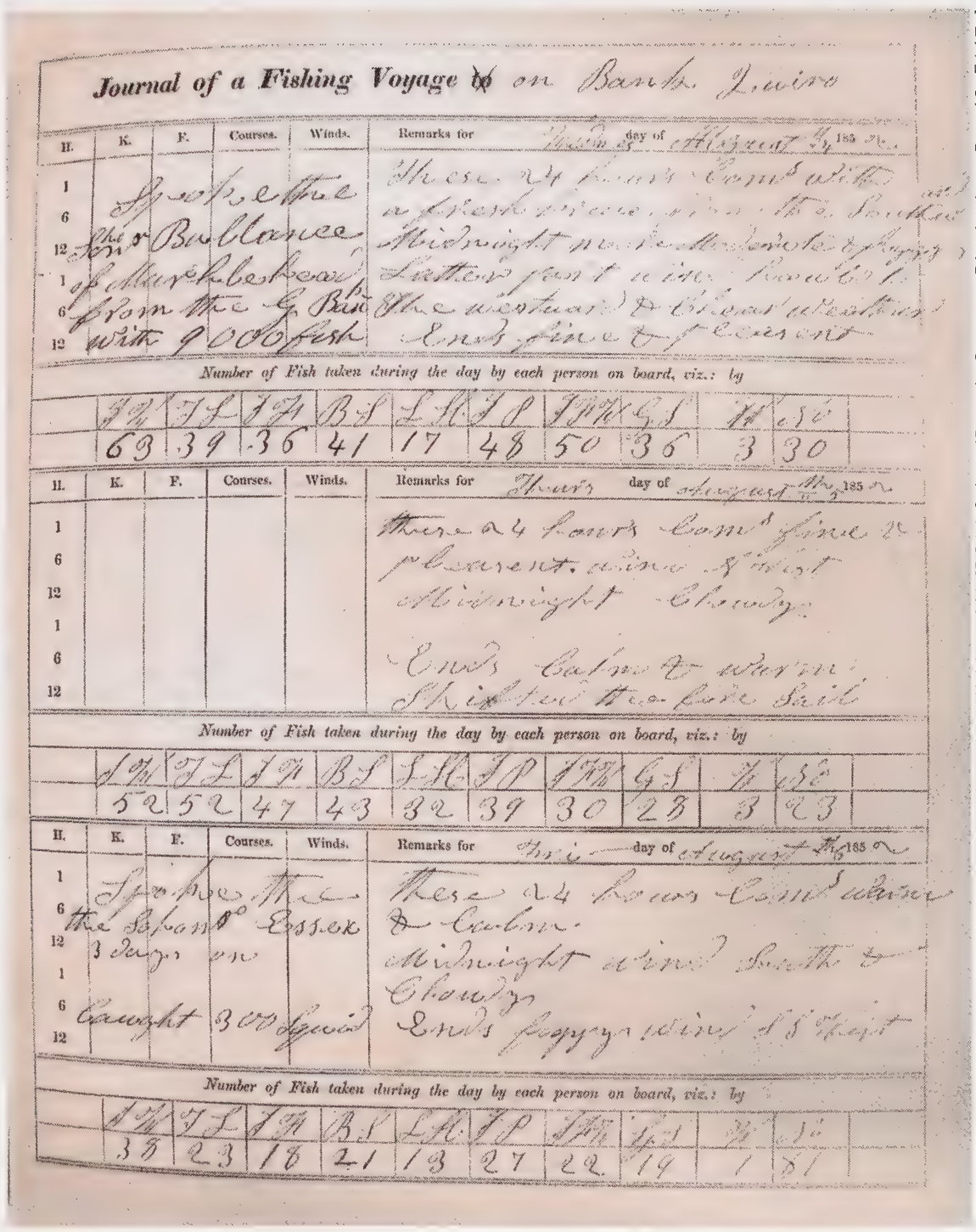
Daniel Botkin, professor emeritus in the department of ecology, evolution, and marine biology at the University of California, Santa Barbara, realized that he could use passages like this one from the Lewis and Clark journals to estimate the density of grizzly bear populations in the early 1800s. He counted 37 individual grizzlies mentioned over the course of about 1,000 miles during the westbound journey, which he calculated to be 3.7 grizzlies per 100 square miles. (He used square miles because he assumed the men could see about half a mile on either side of their route, giving a width of one mile to their 1,000-mile-long transect.) In his 1995 book, *Our Natural History: The Lessons of Lewis and Clark*, Botkin points out how strongly his results rely upon his assumptions. If, he says, he had estimated that the men could see one kilometer on either side of their route, instead of half a mile, he would have ended up with 5.7 grizzlies per 100 square miles. However, he notes that grizzly experts Frank and John Craighead estimated a similar density of the bears in Yellowstone during the 1950s through 1960s—between about three and five bears per 100 square miles.

"Captain Clark and his men shooting bears," from an 1810 printing of the Lewis and Clark journals.

Patrick Gass

Researchers at Oregon State University used the Lewis and Clark journals in a different way. As a doctoral candidate, Andrea Laliberte read them to find clues to the relationship between human settlements and wildlife abundance. "I was really impressed with the detail that [the Corps] recorded," Laliberte says, "considering they were on the river or horseback 12 hours a day, making camp every night, hunting their own food."

Laliberte, now a rangeland remote-sensing scientist at the U.S. Department of Agriculture's Jornada Experimental Range in


Journal of a Fishing Voyage on Banks Lewis

H.	K.	F.	Courses.	Winds.	Remarks for Thurs day of August 185
1					These 24 hours Comd with
6	Spoke the				a fresh breeze
12	Ship Balance				Midnight moderate & foggy
1	of Marblehead				Latter part wind
6	from the G. Banks				the westward & clear weather
12	with 900 fish				Ends fine & pleasant

Number of Fish taken during the day by each person on board, viz.: by

63	39	36	41	17	48	50	36	3	30

H.	K.	F.	Courses.	Winds.	Remarks for Thurs day of August 185
1					These 24 hours Comd fine &
6					pleasant wind S West
12					Midnight Cloudy
1					
6					Ends Calm & warm
12					Shifted the fore Sail

Number of Fish taken during the day by each person on board, viz.: by

52	52	47	43	32	39	30	23	3	23

H.	K.	F.	Courses.	Winds.	Remarks for this day of August 185
1					These 24 hours Comd calm
6	Spoke the				& Calm
12	the Schr Essex				Midnight wind South &
1	3 days on				Cloudy
6	Caught	300 fish			Ends foggy wind S S West
12					

Number of Fish taken during the day by each person on board, viz.: by

38	23	18	21	13	27	22	19	1	21

National Archives and Records Administration, Waltham MA [RG36 Salem/Beverly Customs District Log: Box 62, F467a]

An 1852 logbook entry documenting the catch of the schooner *The Dove* on the Scotian Shelf. That year, the vessel landed about 10,500 pounds of cod.

Las Cruces, New Mexico, tracked nine different species in the journals: deer (a generic term for both white-tailed and mule deer), elk, bison, pronghorn, bighorn sheep, grizzly bear, black bear, wolf, and beaver.

She made a spreadsheet of the latitude and longitude of each of Lewis and Clark's 506 campsites, then noted for each day which species the men mentioned in their journals, general descriptions of the quantity of wildlife, the number of individual animals the expedition killed, and the presence of any human settlements within 50 kilometers (31 miles) of the campsite.

"Their observations were really reliable because they were living off the land," Laliberte says. The men needed wildlife for meat, buffalo robes, and leather to make moccasins and ropes. According to the journals, the party needed either four deer, one elk and one deer, or one bison per day. The daily records of animals killed corroborate that and give credence to the daily tally. In areas of sparse wildlife, such as the Columbia Basin in present-day Washington and Oregon, the company ate some of their horses and dogs. Lewis and Clark kept separate journals and several other men on the expedition did as well, so Laliberte was able to compare observations from several sources for most days.

Were Lewis and Clark seeing what America looked like before Columbus landed? Probably not. Smallpox and other European diseases swept the continent before Lewis and Clark did, killing millions of native peoples. There's no widespread agreement on a number, but some archeologists estimate that 90 percent of indigenous peoples may have succumbed to disease in the first couple of centuries after 1492. Lewis and Clark's journals mention abandoned Native American villages, pock-scarred Native Americans, and stories told by survivors about the diseases that ravaged their villages. Laliberte says, "The abundance that Lewis and Clark saw could very possibly be a rebound caused by lower human pressure."

Despite the fact that Lewis and Clark were traveling through land supporting a recently reduced population of humans, Laliberte and her advisor, William Ripple, found that the proximity of human settlement affected wildlife abundance and diversity. "In a nutshell," Laliberte says, "when there was a greater density of human settlement, the animal density was less and they saw fewer species. What's sort of surprising is that the human density was very low but I could make out those influences on the wildlife."

How Many Cod Swam in the Sea?

The Lewis and Clark expedition intended to document scientific information, but records and recollections originally valued for other reasons can also yield valuable scientific data. Historical ecologists studying cod are finding solid facts in 19th-century business documents and interviews with older fishermen.

Residents of eastern New England and Canada's Atlantic provinces have fished for cod and other groundfish, which live mostly on the sea bottom, for centuries. But in areas where fishermen of yore landed rich cod harvests, the nets of today's fishermen come up empty. In the 1990s, the area's cod fishery collapsed as a result of hundreds of years of continued harvesting, ever-more-efficient

Drying fish in Newfoundland in the 1820s, when the Atlantic cod fishery was booming.

The fishing industry, Newfoundland, from "Le Costume Ancien et Moderne," Volume II, plate 36, by Jules Ferrario, published c.1820s-30s (colour litho), Bramati, G. (19th century)/The Stapleton Collection, Private Collection/The Bridgeman Art Library

fishing techniques, and a population decline among the cod's prey. Cod still live in the northwest Atlantic, but there are too few to support a commercial fishery.

Atlantic cod.

H.L. Todd/NOAA

When cod migrate to their natal spawning grounds and gather in large schools, they do not feed, so they were not easily caught in the days when fishermen used only hooks and lines. But in the 1920s, fishermen began trawling the sea bottom with nets. Suddenly, what had been a protected stage in the cod life cycle became a vulnerable one—fishermen sought out the huge spawning schools and scooped them up.

Today, scientists are looking into ways to help cod populations rebound. First, they are trying to work out where and how the cod lived. "If you don't know what existed before, there's no way on Earth you can hope to restore it," says Ted Ames of Stonington, Maine. Ames is a lobsterman with a master's degree in biochemistry who received a MacArthur Fellowship in 2005. He used an ingenious combination of oral history, personal knowledge, and scientific evaluation to reconstruct spawning grounds and migration routes for cod in the Gulf of Maine in the 1920s.

Like his ancestors, Ames has spent most of his life as a commercial fisherman. He realized that older fishermen would have the knowledge he needed to begin reconstructing where cod lived decades earlier. "Fishing isn't a random poking around looking for something," Ames says. "Many of the shoals and fishing grounds have been known for centuries. What's happened traditionally in the coastal fisheries is, once an area was fished out, it ceased to exist—nobody had any continuing knowledge of it." Scientists call this phenomenon "ecological amnesia."

Historical ecologists studying cod are finding solid facts in 19th-century business documents and interviews with older fishermen.

Ames identified fishermen who had worked in the Gulf of Maine between 1930 and 1960; most of them were in their 70s and 80s. Many had to be persuaded to share what they knew. "It's very touching, because that information was proprietary," Ames says. "[It] traditionally passed from father to son and rarely spread any further." Ames told them, "Number one, there are no fish there anymore, and number two, the sole purpose of what we're doing is to try to rebuild the population of cod and haddock along the coast so that we can again have a credible fishery—only this time, use it sustainably." He was able to interview 28 of the 32 fishermen he contacted.

Because he was asking people to rely on memories of events that occurred decades earlier, Ames developed several criteria for the data he collected: Before he identified any area as a historical spawning ground, it had to be reported independently by at least two sources, it had to be an appropriate depth for cod spawning (ten to 100 meters, or about 30 to 300 feet), and the bottom had to be an appropriate substrate for spawning—sand, gravel, or muddy gravel. He supplemented and corroborated his interviews with information from early U.S. Bureau of Commercial Fisheries reports and U.S. Fish & Wildlife Service bulletins.

"We recorded nearly a thousand square miles of historic spawning grounds that had hitherto been unknown to the scientific community," Ames says. About half of these spawning grounds are now abandoned; others are sparsely populated.

Ames also asked the fishermen about the relative amounts of fish they caught at various times of year. Using these data, he mapped spawning grounds and directions of movement of different cod subpopulations during the year. He says that recent tagging studies have so far corroborated his theories on the directions and timing of cod migration.

Although cod fishermen in the 1920s and '30s were able to make a living, the fishery was depleted even then. "That's part of the folklore of fish in these old fishing communities," Ames says. "The big collapse in the mid-coast area came somewhere around the turn of the century, somewhere between the 1880s and 1920." The development of trawling and other innovations extended commercial fishing of cod into the 1990s.

Other scientists are also using historical ecology methods to help pinpoint the timing of the big collapse. The Gulf of Maine Cod Project is codirected by historian Jeffrey Bolster and ecologist Andrew Rosenberg of the University of New Hampshire. With another colleague from the university, biostatistician Andrew Cooper, the interdisciplinary team is using various historical, ecological, and statistical methods to quantify cod populations off the coast of northeast North America over the past 400 years.

"There's an extraordinary debate going on today about rebuilding marine ecosystems," says Bolster. "How many fish do we want? How many fish did there used to be? How many fish can swim in the sea? How can fisheries managers begin to even think of making policies and aiming at targets if they don't know where they are aiming?"

To date, the group has analyzed data from schooners that worked the Scotian Shelf (just off the southern coast of Nova

MVZ Archives

Joseph Grinnell (far right) with members of his survey team at Cedar Canyon in San Bernardino County, California, in 1938.

Scotia) between 1852 and 1859. These schooners sailed offshore twice a year on multiweek trips, and used baited lines to catch cod. Onboard logs documented the number and location of cod caught, how much fish by weight was sold at the end of the trip, and, often, how much cod nearby schooners caught. The federal government also paid each captain and crew a bounty based on the size of the ship. Using all of these sources allowed Bolster and his colleagues to check and cross-check the information.

The numbers show a clear pattern over time: "These guys watched their annual landings decrease about 50 percent from 1852 to 1859," Bolster says. In fact, by 1859, many of the schooners were abandoning the Scotian Shelf for different waters.

Using statistical population modeling methods, the Gulf of Maine Cod Project estimated the total biomass of cod on the Scotian Shelf in 1852 at 1.26 million metric tons. Today, the area is thought to support 50,000 metric tons of cod, just four percent of the 1852 estimate.

The group is now working with similar data from smaller boats that fished along the central coast of Maine in the 1860s. "We're astonished as to how many tons of fish were landed by these small boats," Bolster says. "They were catching fish in all sorts of places where there aren't any fish today."

Grinnell Resurvey Project

Nineteenth-century fishermen probably did not anticipate their logs' value to future ecologists, nor could Lewis and Clark have anticipated how their journals would one day be used. But in the early 1900s, California biologist Joseph Grinnell embarked on an immense documentation project expressly to produce an ecological record that would be useful to scientists yet unborn. You might call it "planned historical ecology."

Grinnell was the director of the Museum of Vertebrate Zoology at the University of California in Berkeley from its founding in 1908 until his death in 1939. A man of unusual foresight, he wrote in 1910, "I wish to emphasize what I believe will ultimately prove to be the greatest purpose of our museum, and this is that the student of the future will have access to the original record of faunal conditions in California and the west."

During the first four decades of the 20th century, Grinnell and others recorded 13,000 pages of meticulous field notes, collected and preserved thousands of specimens, and took 2,000 photographs documenting California's birds, mammals, reptiles, and amphibians. "These records were left explicitly for people to use in the future," says John Perrine, a wildlife biologist at the museum.

And that is just what is happening. The museum's current director, Craig Moritz, has launched an ambitious project to retrace Grinnell's steps to quantify how the ecology of California has changed during the 20th century, and to leave a record for future scientists. The Grinnell Resurvey Project is focusing first on the seven areas for which the Grinnell team gathered and distilled their observations into lengthy books.

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Perrine says, "Our goal is to go back to the exact same spot on the map and use methods similar to theirs." The resurvey team is spending most of their time on small mammals and birds, as Grinnell did.

To survey birds, Grinnell and his colleagues walked a trail and at regular intervals wrote down all the bird species they saw or heard. "We can walk that same trail at the same time and same date [day of the year]," Perrine says. For small mammals, the Grinnell team set out traps; today's teams do the same, but release most of the mammals they identify.

Perrine is heading up the resurvey effort in the Lassen area—a 3,000-square-mile rectangle in northern California that includes Lassen Volcanic National Park—that began last summer. A team

headed by Jim Patton, a retired biology professor and curator of the museum, surveyed the first area, which includes Yosemite National Park, from 2003 to 2006.

So far, the Yosemite data have yielded some interesting insights. Chief among them is that the ranges of some small mammals have changed in relation to elevation. For example, the ranges of the alpine chipmunk (*Tamias alpinus*), the pika (*Ochotona princeps*), and several other small high-elevation species have shrunk upward—they no longer live in the lower-elevation parts of their former ranges. Some other small mammals have enlarged their ranges by expanding up, with the result that there are four small mammals found in Yosemite today that were previously confined to lower-elevation areas along the boundaries of the park. "The most dramatic of those is the piñon [deer] mouse [*Peromyscus truei*]—a 25-gram [about one ounce] mouse with huge ears," Patton says. "The eastern part of the population has extended upward almost 2,000 feet. It's an extremely significant shift."

Is global warming driving these populations upward? There is some evidence of warming in the park, including the fact that the glacier on Mt. Lyell in Yosemite is about a third of the size it was a century ago. The range changes of the small mammals are consistent with what would be expected due to global warming, but, as John Perrine points out, "that doesn't mean that's what caused it. Figuring out cause and effect is always difficult." He is interested to see whether small mammals exhibit similar patterns of range change in other areas as the resurvey project continues.

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This map of Lyell Canyon in Yosemite, drawn by a member of the original Grinnell survey team in 1915, shows the capture site of a wolverine, a species that probably does not live in the area today.

The field data are already being used in diverse ways. Scientists are comparing the DNA of specimens from Grinnell's time to those of today to shed light on questions such as whether a species loses genetic diversity as its range shrinks, and are using past and present data to test computer programs that model global warming. They may also compare specimens to determine whether species have changed physically over time.

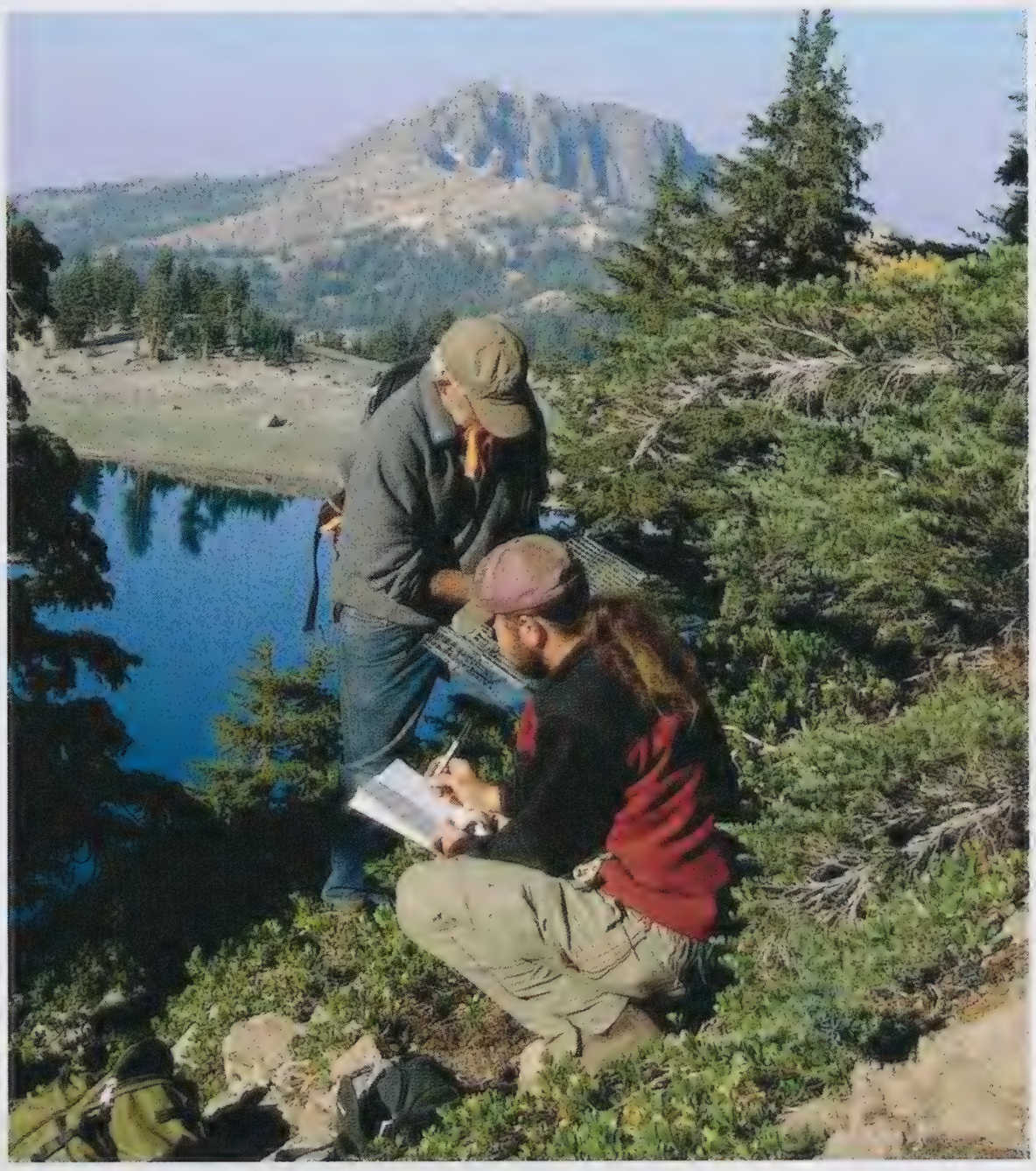
Although it's dizzying to imagine how many research projects could be generated by the resurvey project, Perrine tries to stay focused on the data-collection process itself. He and Patton and others on the team know that future scientists are depending on them.

With that in mind, the resurvey project is not only duplicating Grinnell's work but improving on it, by adding modern equipment such as mist nets for catching birds and GPS for locating collecting sites, and by standardizing their methods. "We're mapping all of our sites to great detail, and including standardized habitat descriptions, with the goal that 20 or 100 years from now someone will be able to replicate exactly what we did," Patton says.

"Grinnell knew that his information would be used in ways he couldn't imagine," Perrine says. "That's something we try to keep in mind—researchers in the future will use this information in ways that *we* can't imagine. The best we can do is to be clear in our methods and leave them the best data possible."

Thanks to the foresight of Grinnell and his team, historical ecologists studying small mammals and birds of California in the 20th century have a wealth of accurate and reliable data. And when the Grinnell Resurvey Project wraps up in a decade or so, an almost unimaginable richness of data will be available and waiting for people who will use it in unimaginable ways. Z

Scientists Jim Patton (standing) and John Perrine check small-mammal traps in Lassen Volcanic National Park as part of the Grinnell Resurvey Project.



Amanda Hawn/MVZ Archives

—Mary-Russell Roberson is a freelance writer living in Durham, North Carolina. She and Kevin Stewart recently coauthored a new book, Exploring the Geology of the Carolinas: A Field Guide to Favorite Places from Chimney Rock to Charleston.

Few people have heard of small cats like this Asian golden cat, and even fewer think about their conservation. Traditionally, small cats have received little attention from scientists, despite the fact that they comprise more than half of all cat species.

Art Wolfe/www.artwolfe.com

small cats, LOOMING LARGE

BY JOHN TIDWELL

Zerenlamu pulled her twisted, black braid aside and leaned close to the well-thumbed field guide, studying its images for several minutes. Then she sat up and roughly slapped the page with the back of her hand. "We have this cat," she said with typical Tibetan finality.

In the summer of 2003, ecologist Jim Sanderson had been traveling for weeks, in and out of almost every remote village in northwestern Sichuan Province in China, searching for evidence of the Chinese mountain cat (*Felis bieti*), one of the rarest wild felines on Earth. But every time he asked, locals stared blankly at the book's illustrations and shook their heads, saying, "No, we've seen nothing like that."

Now, amid the bustle of a local greasy spoon in a rustic town nestled high in the foothills of the Tibetan Plateau, there was a glimmer of hope. A grizzled hunter hunched next to Zerenlamu eyed the drawing and snorted that it was a different animal—"the one with long hair"—and pointed at Pallas' cat (*Felis manul*), a more common local species. But the stout Tibetan housewife was resolute. "I've caught this cat," she said gruffly. "I've skinned it and made it into hats. I *know* this cat."

Sylvester Drubgyal

When searching for rare small cats, scientists may follow a trail of skins before finding a living specimen. Here, Jim Sanderson (right) and a Tibetan woman hold a Chinese mountain cat skin.

Sanderson asked where she'd caught it, and Zerenlamu gestured west, toward the snowcapped peaks of the plateau. Anecdotal, perhaps, but for Sanderson and other scientists who venture out to the world's wild places seeking "mystery species" like the Chinese mountain cat, getting insights from locals is a crucial first step.

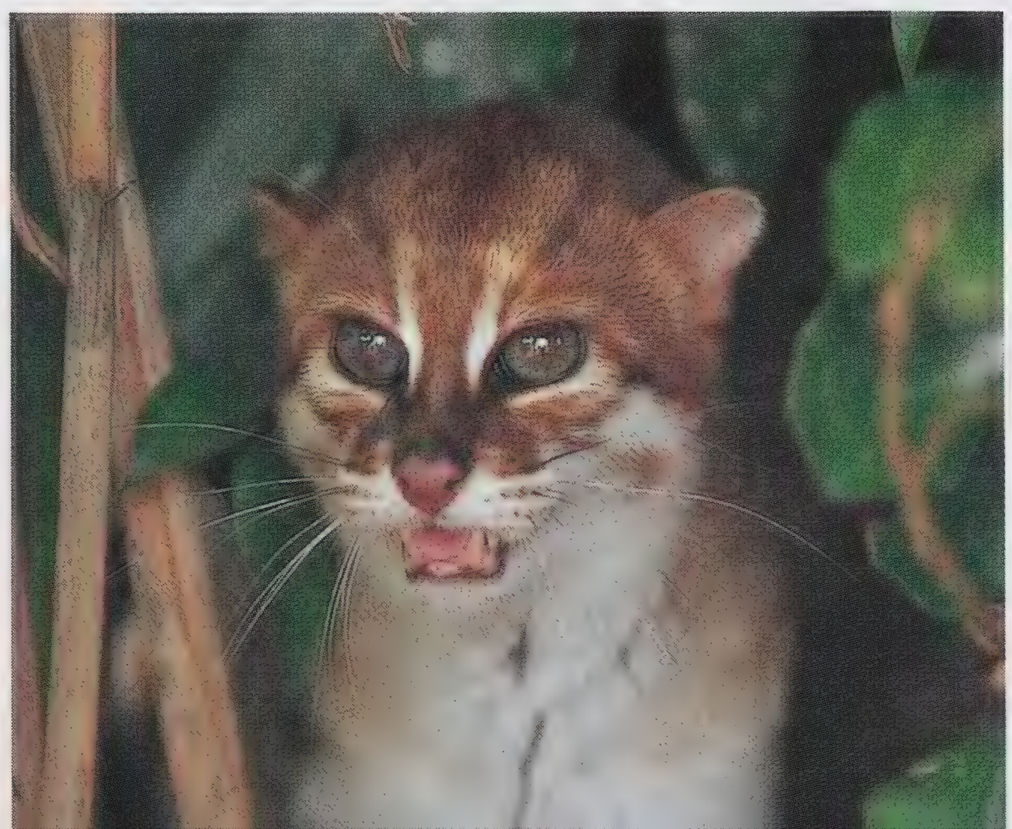
Lanky, with a perpetual silvery stubble, 57-year-old Sanderson has a reputation for being a flinty iconoclast who can track down "unfindable" cat species others have sought in vain. In 1997, he was the first to study the petite kodkod (*Leopardus guigna*) in the Chilean wilderness. Two years later, he headed into the high Andes to take the first photos of the supposedly extinct Andean mountain cat (*Leopardus jacobitus*). And last year, after many weeks looking for the Chinese mountain cat on the Tibetan Plateau, Sanderson flew to the island of Borneo, trekking through jungle in search of the spoor of the bizarre flat-headed cat (*Prionailurus planiceps*).

While such fieldwork may seem like high adventure, it's more often arduous, exacting work that requires great tenacity, resourcefulness, and the unswerving dedication of an apostle, qualities common to many small-cat scientists like Sanderson. But why do all this for an elusive creature that spits and hisses when you come near? Sanderson's gaze is unwavering, fervid, almost *feline*. "Cats are without question nature's most perfect creatures," he says. "We suspect that almost every species in the cat family is in danger of extinction, and most people don't even know they exist. Something must be done."

The Forgotten Majority

Everyone's heard of the big cats—lions and tigers—and most of us are even aware that they are endangered. For centuries these animals have been potent symbols of power and majesty in our culture, and many people find the idea that big cats could disappear forever deeply unsettling. Large, conspicuous felines have also been easier for scientists to study in the wild. As a result, big-cat conservation has received the lion's share of publicity and funding for nearly half a century. During that time small, wild cat species, usually classified as those weighing less than 45 pounds, were often overlooked or considered less worthy of study.

Flat-headed cat.



Art Wolfe/www.artwolfe.com

John Seidensticker, a preeminent cat biologist who heads the Smithsonian National Zoo's Species Conservation Center, remembers the reaction of his Nepalese colleagues when he suggested including a few local leopards in his Smithsonian study of wild tigers in Nepal during the 1970s. "They said, 'Why are you wasting your time and money on leopards? They aren't important,'" recalls Seidensticker. "Imagine if I had wanted to study a little jungle cat. People would *really* have looked down their nose at me."

Most of the cat family—six of the eight major lineages and more than half of all 40 cat species—are small.

Most of the cat family—six of the eight major lineages and more than half of all 40 cat species—are small. They are found on every continent except Australia and Antarctica, and in less than ten million years (brief by evolutionary standards) have evolved to live in many different ecological niches: from southern Asia's water-loving fishing cat (*Prionailurus viverrinus*) to the black-footed cat (*Felis nigripes*), which roams the deserts of southern Africa.

The majority of these small felines appear on the World Conservation Union's (IUCN) Red List of Threatened Species, but most people are familiar with only a few: the ocelot (*Leopardus pardalis*), the bobcat (*Lynx rufus*), the lynx (*Lynx* spp.), and, of course, the domestic housecat (*Felis catus*). The rest remain ciphers, even to their neighboring villagers. Scientific information on most small, wild cat species remains cursory at best. In many cases, their population numbers are estimated based on the size and condition of the forests they are thought to inhabit. Whether they are actually *there* is anyone's guess.

Frans Lanting/franslanting.com

Legal protection has helped revive Eurasian lynx (*Lynx lynx*) populations.

Seidensticker says that until recently, experts considered the jungle cat (*Felis chaus*) to be a relatively common species, primarily found in wetlands and forests from Vietnam to the Nile Valley. But when scientists at the Wildlife Conservation Society surveyed its Southeast Asian population in 2003, they discovered most reports were based on a single Cambodian specimen. In fact, the researchers found that jungle cats are now very rare from Thailand to Vietnam and completely gone in Laos. No one knows their status outside of Southeast Asia, and experts fear they may be one of Africa's rarest cats. If this could happen to a supposedly common species, what about those thought to be rare? "Most of what we know about these small cats comes from old reports and stuffed museum specimens," says Seidensticker. "For many of them, we have no information at all. They could go extinct under our very noses and we wouldn't know it."

What to do? Seidensticker says there is currently no organized conservation strategy specifically for each of the small cats. Usually, scientists hope that existing projects designed to protect big cats, which need large areas of forest to roam in, will also benefit small felines that live there too—and to a degree, they probably do. But what about those who live where there are no lions and tigers, like the Chinese mountain cat? And are the threats facing big cats really the same for small ones? Indeed, so little is known about small wild felids that a one-size-fits-all strategy might not work well enough to prevent their continued decline.

The only solution, most cat specialists agree, is to lace up the hiking boots and go looking for these elusive felines in the wild, gathering precise data about where they are, what they need, and why they are disappearing. But how do you find increasingly rare small-cat species (most really good at hiding) in often vast, inaccessible places?

Desperately Seeking Wild Cats

Looking for secretive animals like the Chinese mountain cat can often appear quixotic, even to other scientists. After abandoning a 20-year career as a top Los Alamos National Laboratory mathematician to teach wildlife ecology, Jim Sanderson headed down to southern Chile in 1997 to search for the kodkod, a speckled cat that his colleagues said couldn't be found. Exploring Isla Grande de Chiloé, an island off the Pacific coast, he found the kodkod in just two weeks, and returned later to conduct the first field study of this tiny feline. In 1999, when Sanderson flew high into the Chilean Andes to find the legendary Andean mountain cat, experts doubted he'd catch anything but a cold. But he succeeded again in less than a year, with the help of Bolivian researchers Lilian Vilalba and Elisao del Gado.

When Sanderson first sought the Chinese mountain cat in the summer of 2002, he had to do it on his own time, during an unrelated tree survey in China's Sichuan Province. During the month

LIVING SMALL

Dividing the cat species into small, medium, and large seems more like describing pizza than doing science. But this simple categorization actually reflects meaningful differences among the felids in what and how often they hunt and kill.

Lions are notoriously lazy. Lions, along with tigers, are the large cats, typically weighing between about 300 and 400 pounds. They rest 19 or 20 hours a day when prey is abundant and, even when it's not, 14 hours of rest a day is the norm. Domestic cats, which fall in the small category, are pretty indolent too. But pampered, well-fed house cats are not typical of their wild, small-size cousins. Fifteen- to 30-pound ocelots, for instance, actively hunt for small rodents 12 to 14 hours a day. And while a lion takes about 30 zebra, wildebeest, and similar large prey a year, and a tiger about 50 hefty sambar deer and wild pigs, a 17- to 40-pound serval captures about 6,000 small rodents, snakes, and birds in a year!

Tigers and lions hunt large animals, often larger than themselves, and they have no choice. While they might occasionally snatch up smaller creatures like hares and such, tigers and lions can't survive on such diminutive fare—over the long term, it takes more energy to catch enough of such morsels to feed large bodies than they're worth.

The medium-size cats, weighing between about 90 and 175 pounds, are jaguars, leopards, snow leopards, pumas, and cheetahs. Except for the lightly built cheetah, these cats prefer and are strong enough to take large prey when it's available, but can make do with smaller stuff. A puma, for instance, thrives on elk and deer but can meet its needs with rabbits, hares, and ground squirrels when bigger packages of protein are scarce. And large prey for a leopard is proportionately smaller than large prey for a tiger: Leopards are about a fourth the size of tigers and so are their prey. Among these cats, activity levels and kills per year vary accordingly.

In contrast, small cats, those less than about 45 pounds, rely almost entirely on prey smaller than themselves, primarily hares and rabbits, rodents, and birds. With a few exceptions, the small cats don't seem to be powerful enough to bring down bigger creatures. And this gives them little time for lolling around between meals. In fact, smaller cats must eat proportionately more than larger cats. On average, big cats consume about half an ounce per day per pound of their body weight, medium-size cats such as pumas just under an ounce per day per pound, and ocelot-size small cats one to one-and-a-half ounces.

The very small "microcats," such as black-footed cats, rusty-spotted cats, and kodkod, which weigh from two to six pounds, have huge appetites, consuming two to two-and-a-half ounces per day per pound of body weight. Compared to lazy lions and even to busy ocelots, these tiny cats are dynamos. Hunting is an all-consuming task, and what little is known of the diets of these cats suggests they eat just about anything that moves and is smaller than they are.

Small cats differ from the large and medium-size cats in another important way, too. While adult large and medium cats have no or few predators and competitors, small cats have plenty of both! Small cats compete with predatory birds, some snakes, and weasels for rodent and bird prey, and may also be eaten by snakes and birds of prey, as well as killed by cats of larger species when their ranges overlap. So while all cats tend to be secretive, the small cats are especially so—one big reason why many people aren't even aware these feisty little felines exist.

—Susan Lumpkin

Rusty-spotted cat.

Art Wolfe/www.artwolfe.com

he was there, Sanderson did what most mammalogists do when they start searching for species: He went to every rural marketplace he could find. If the cat still existed, hunters would probably be selling its shaggy pelt in town. Weeks passed with no luck, until one evening when Sanderson noticed a tawny fur hanging in a village shop. The owner claimed it was a fox. "They had stretched out its nose with a light-up toy beeper," Sanderson recalls. "But as I looked at it, I realized this was actually a cat skin!" Confirming that it was the mountain cat in his handbook, Jim bought his scientific proof for about $4, and later used it in regional conservation lectures. The strategy worked: During one talk, a man stood up and said it was the kind of fur he'd slept on as a baby in the far western countryside.

Two successive trips to western China (still during off hours from other jobs) yielded more skins and a startling deduction, gleaned from Tibetan hunters who referred to *Felis bieti* as a "grass cat." "Scientists first called it a desert cat, then the Chinese steppe cat, then the Chinese mountain cat," says Sanderson. "But we learned it's not in montane forests at all, it lives in high-elevation grasslands. So all these years, people were looking in the wrong habitat."

When Sanderson returned to China last summer, he used these insights to chart a new location for his quest: the vast windswept plains of Kekexili National Nature Reserve, some 17,000 square miles of alpine grasslands where western Qinghai Province vaults into the Tibetan Plateau. Averaging 15,000 feet above sea level, the reserve is isolated, like an island in the sky. Scientists suspect this "Lost World" is home to a rich spectrum of plant and animal species, many still unknown to science. Sanderson's battered white vans followed the wide Qumar River out to a dusty Tibetan village called Cuochi, where local herdsmen nodded at the picture of the mountain cat, and then produced a pelt Jim recognized instantly as Pallas' cat. But what these villagers lacked in scientific knowledge, they made up for in experience. From them, Sanderson learned that, like the Pallas' cat, mountain cats probably live in burrows, but hunt at night. "When it snows," the hunters said, "you can follow the cat's tracks to its den."

Sanderson returned to China in January 2007 with the backing of private conservation groups. This time, he headed for the southeastern edge of the Tibetan Plateau, armed with high-tech tools that have revolutionized field research in recent decades: camera traps and collars fitted with radio transmitters. Because the mountain cat may be nocturnal, Sanderson also brought night-vision binoculars that can pierce the deepest gloom.

Capturing a Ghost

Frozen in mid-stride, the cat looks serene, like a monarch surveying his realm with whiskery satisfaction. In June 2003, the first image ever taken of a bay cat (*Catopuma badia*) in the wild was snapped by the animal itself, as it walked through the undergrowth of Borneo's Bentuang Karimun National Park. Zoologist Mohammed Azlan of the University of Malaysia in Sarawak, had set up the camera trap deep in the jungle, and left it there for two months. When the bay cat padded by one day, the camera's infrared sensor detected its body heat and snapped a photo, documenting its identity in a flash.

Art Wolfe/www.artwolfe.com

The black-footed cat is one of the world's smallest felines; large males weigh just over four pounds.

Scientists have used camera traps since the 1930s, but they were often a hit-or-miss way to collect data. When zoologist Ullas Karanth used them to study tigers in India, he found that by arranging many cameras in a grid pattern he could monitor large areas of forest and get information not only where he expected to find tigers, but also where he didn't.

Today camera traps are an indispensable tool for studying animals in the wild. Traditionally, field researchers sat in camouflaged blinds for hours, writing what they saw and trying not to nod off. By contrast, Karanth's remote-photography method allowed small 35mm cameras with motion sensors to document many acres of wilderness simultaneously, day or night, producing more accurate data in a fraction of the time and cost. Venerable cat scientist Mel Sunquist oversaw the installation of camera traps at 135 different sites for a tiger study by graduate student Kae Kawanishi in Malaysia's Taman Negara National Park. The cameras not only got 35 photos of tigers, but also thousands of images of other forest animals. "We got weasels, pheasants, Asian golden cats, wild dogs—who knew *they* were in there?" Sunquist says. "You put out these cameras and you find out everything that's going on in a forest."

Jim Sanderson likes using camera traps because they are particularly effective at capturing images of nocturnal small cats that have long evaded heavy-booted researchers in the wild. In South America and Asia, Sanderson helped launch scores of forest-monitoring studies, training local researchers to use camera traps and

often letting them run the projects. "I always refer to Jim as the 'Johnny Appleseed' of camera traps," chuckles Sunquist. "He runs around the world putting out cameras here and there, seeing if they grow." Azlan was one of Jim's graduate students in northwestern Borneo, who learned to use camera traps to search for rare felines in some of the last intact rainforests. Azlan says that out of thousands of photos he got only one of the bay cat, indicating how perilously small this animal's population must be.

Isolated for millions of years, Borneo's bay cat may be a closed-forest specialist—although it has been recorded in logged-over and secondary forests, its long-term survival in such forests is unknown. More than 30 years of logging, oil palm plantations, and forest fires have now shrunk Borneo's rainforests by half, raising fears in the early 1990s that the bay cat, which went unseen for more than a decade, had become extinct. Then, Azlan's camera trap showed that at least one still remained.

That same year, John Seidensticker and colleagues Eric Wikramanayake and Suchitra Balagalle were hunting for another reclusive feline far to the west, on the island of Sri Lanka as part of a National Zoo study, using camera traps in a very different environment.

Following reports of fishing cat sightings, Seidensticker's team decided to set up its cameras in a location few scientists would have chosen: the middle of Colombo, Sri Lanka's capital city. Centuries earlier, the center of this sprawling metropolis had been a natural wetland, home to stocky, panther-like fishing cats that ranged over most of southern Asia. As the city grew, small areas of wetland remained, hidden in weed-choked canals and undeveloped stands of mangrove. What Seidensticker and his colleagues wanted to find out was how fishing cats, long assumed to be sensitive to habitat damage, could survive amid the hubbub of a big city in mere fragments of wetland. The research would also indicate how these water-loving felines were affected by water pollution.

Wetlands in South Asia, like most parts of the world, have been heavily degraded by agricultural fertilizer, urban development, and drought caused by deforestation. According to a 2004 report in the Indian daily newspaper *The Hindu*, more than 115 wetlands across the subcontinent contained high levels of toxic pollutants, including pesticides like DDT. Because fishing cats are so dependent on swamps and streams, Seidensticker says his ongoing study's data can help scientists in Colombo assess the purity of the area's water by counting how many *P. viverrinus* are there. "Fishing cats are the wetlands version of the canary in the mineshaft," Seidensticker explains. "If the cats are abundant and healthy, the water is clean."

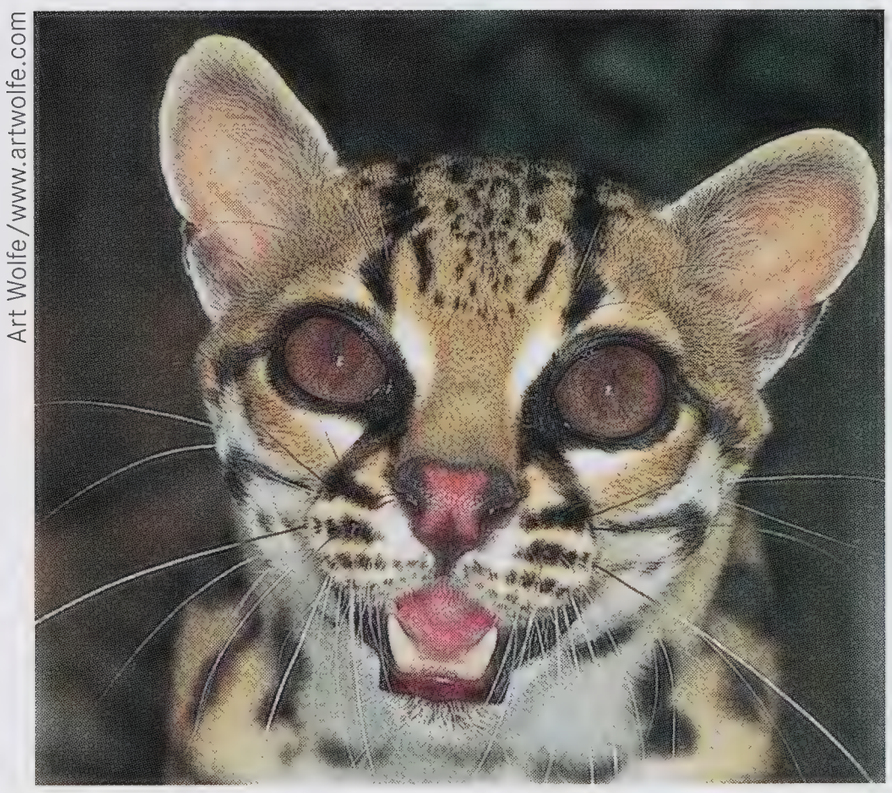
The Clouded Leopard Project, a partnership of Thailand's Department of National Parks, WildAid Thailand, and the National Zoo's Conservation and Research Center, has used camera traps at 22 sites in the Dong Phayayen-Khao Yai National Park complex in Thailand, more than 840 square miles of tropical wilderness. Since it began in 2004, the project's cameras have snapped thousands of photos of rare clouded leopards (*Neofelis nebulosa*) and other small cats including leopard cats (*Prionailurus bengalensis*), marbled cats (*Pardofelis marmorata*), and Asian golden cats (*Catopuma temminickii*), providing a unique glimpse into the lives and habits of these vanishing felids.

In 2003, Texas A&M University-Kingsville's Feline Research Program, led by Lon Grassman, used camera traps and radiocollars to track clouded leopards, Asian golden cats, and marbled cats in the Phu Khieo Wildlife Sanctuary. Once captured and fitted with radiocollars, wild cats and other animals were successfully tracked, even in dense jungle, showing scientists where their home ranges were and what parts of the forest different species preferred.

Art Wolfe/www.artwolfe.com

Marbled cat.

Combining radiotelemetry data with thousands of camera-trap photos not only let the Texas researchers collect lots of valuable new information on many unstudied wild cats, it also provided Thai police with a fascinating way to fight crime, because Grassman's camera traps often took photos of poachers hunting illegally in the national park, letting park rangers and police see where poachers were active.



Art Wolfe/www.artwolfe.com

The arboreal margay (*Leopardus wiedii*) is a little-known small cat from Central and South America.

Protected forests in Thailand have become some of the last refuges of native wild cats in Southeast Asia. But in recent decades, as the pervasive illegal wildlife trade systematically hunted out big cats in the region for their skins, the beautifully spotted fur of smaller felines became the trade's new target—and in greater numbers. While a woman's fur coat, for example, might require the pelts of two large leopards, a similarly sized garment might need 20 or more marbled-cat skins. Even though international trade in leopard cats, marbled cats, and Asian golden cats has been forbidden since the 1970s, illicit shipments of their skins, bones, and body parts continue to be discovered by customs officials, most heading for the markets of China, where international law often can't follow.

As the pervasive illegal wildlife trade systematically hunted out big cats for their skins, the beautifully spotted fur of smaller felines became the trade's new target.

Most cat scientists agree that to be effective, efforts to curb or eradicate the illegal wildlife trade must include reducing or eliminating demand for wildlife products in consumer countries, and better control of poaching in forests where the wildlife trade starts. If wild cat populations in these countries are regularly tracked, it should become clear when and where some species begin disappearing. These kinds of precise data could also help police in high-poaching countries like Thailand take a bite out of the illegal wildlife trade.

As the results of isolated studies of small cats like those in Thailand began to filter in, concern about the cats' survival has escalated in recent years among scientists and conservation groups. The more than 200 experts that make up the IUCN's Cat Specialist Group also helped launch a variety of small-cat research projects, including one on the bay cat in Borneo's eastern Danum Valley that was funded by the nonprofit Cat Action Treasury. Sanderson teamed up with Conservation International and the Wildlife Conservation Network to create the Small Cat Conservation Alliance, which now funds field work and helps draw attention to the plight of diminutive cat species.

The People's Wild Cat

As he put his mountain-cat skin away after giving a conservation lecture in China last year, Jim Sanderson was approached by a student. Known by his single Tibetan name of Drubgyal (Sylvester to his Western friends), the young man told Sanderson he wanted to help find *Felis bieti*, and that shaggy wild cats near his home village in northern Sichuan Province looked very much like the tawny pelt Jim had just displayed. It was a lucky break for the American scientist.

In February of last year, Sanderson and Yin Yufeng, a graduate student from Beijing University, followed Drubgyal to the village of Longhri, in Sichuan's Nyawa Tibetan and Chang Autonomous Prefecture. Its rolling hills dotted with herds of yak and round Tibetan *ger* tents, Longhri is only about 11 miles west of the town where Zerenlamu first recognized the mountain cat in Jim's field guide. Operating on a shoestring budget in frigid, snowy conditions, Sanderson and his two students have now spent months in the surrounding hills setting up some 40 camera traps, measuring paw prints, finding likely burrows, and observing local rodents that mountain cats might hunt. Such basic information is gradually forming a picture of the feline's role in this alpine ecosystem, and helping determine the best way to protect it.

As always, Sanderson is being "Johnny Appleseed." He is training Yin and Drubgyal to be keen scientists, and he often invites villagers from Longhri to help with survey work, so they can become some of the cat's most ardent protectors. It's a strategy that the conservation community has increasingly embraced: Show locals how safeguarding their environment and its wildlife by preserving natural resources, ranching livestock sustainably, and creating ecotourism in their area can benefit their communities. Sanderson says it's a very Buddhist concept that the Tibetans of Longhri understood immediately. "The more they learn about it, the more they see it as *their* cat, a legacy of *their* land," he says. "For small cats and other threatened species, that's the best protection you are ever going to find." Z

—John Tidwell is a freelance journalist who lives in Silver Spring, Maryland.

LEKKIN' GROUSE on the Prairie

BY HOWARD YOUTH

The words *leks* and sex are related, and by some cosmic coincidence they even rhyme. Lek is a Swedish term for "sex play" or "mating sport." It is also a scientific term for a spot where males of a certain species convene to strut their stuff en masse, competing head-to-head for the favors of onlooking females.

Lekking species include the walrus (*Odobenus rosmarus*), some fruit bats, zippy little rainforest birds called manikins (*Pipra* spp.), and a few antelope species. But the most famed lekkers are grouse. In fact, the term lek was first coined in the 1867 book *The Game Birds and Wild Fowl of Sweden* by author Llewelyn Lloyd, to describe Scandinavian grouse courtship behavior.

John Cancalosi/naturepl.com

A sharp-tailed grouse struts his stuff at a lek in Colorado. Males of some North American grouse species make a spectacle of themselves while competing for mates.

Carol Walker/naturepl.com

A greater sage-grouse inflates his air sacs on a lek in Wyoming.

Of the world's 19 grouse and ptarmigan species in the subfamily Tetraoninae, only seven defend small territories on large leks. Five of these—the greater and lesser prairie-chickens, sharp-tailed grouse, and greater and Gunnison sage-grouse—live in North America. Over the centuries, males in these species have captured not only female grouses' attention, but also the notice of ornithologists and the imagination of the birds' human neighbors.

Native Americans, for example, emulated the spring mating rituals of prairie-chickens on North American plains with their wriggling, shaking, stomping, and feather-flipping prairie-chicken dance. Prairie-chicken dances held an honored place in many powwows, and—like the birds' displays—took place after harsh prairie winters. Mimicking the prairie-chickens, male dancers pranced around inside a circle, their female counterparts watching from outside the ring. The strutting display of sage-grouse and the tail-pointing of sharp-tailed grouse also inspired Native American dancers.

Native Americans emulated the spring mating rituals of prairie-chickens with their wriggling, shaking, stomping, and feather-flipping prairie-chicken dance.

The bizarre choreography, ritualized dances, and otherwordly sounds of lekking-grouse displays take full advantage of the wide-open spaces inhabited by these birds. At traditional lekking grounds, the birds assemble before sunrise and activity peaks not long after the sun peeks over the flat or hilly horizon. Although predators often come calling early in the morning, they may not stop the show for long. "I've seen a golden eagle flush a greater sage-grouse at a lek," says wildlife photographer Robert E. Mumford, Jr., who has photographed all of North America's lekking grouse. "But soon after, the grouse walked or ran back in to the lek." In 1908, ornithologist Frank M. Chapman noted how quickly displaying greater prairie-chickens converted from gaudy exhibitionists to dingy, round-bodied birds. He wrote: "The sight of a passing hawk changes the grotesque beplumed, be-oranged bird into an almost invisible squatting brownish lump, so quickly can the feathers be dropped and air sack deflated. With woodland birds so great a change is unnecessary, but the prairie hen can hide only under its own feathers." Recent research indicates that some males set up leks in areas with less long-range visibility, which may reduce their vulnerability to predators.

Compared with non-lekking grouse and many other birds, these males defend small individual territories within their lekking grounds. Sage-grouse, for example, defend territories of between six and 120 square yards, on leks that may span two-and-a-half to 40 acres. Greater prairie-chicken males average territories of 620 square yards, an area roughly one-ninth the size of a football field. Lesser prairie-chicken and sharp-tailed grouse turf is even smaller—between 50 and 180, and 55 and 310 square yards, respectively. Non-lekking grouse typically defend larger areas. Males of the forest-dwelling ruffed grouse (*Bonasa umbellus*) of northern North America, for example, defend territories of more than five acres, an area that could accommodate five football fields or more.

On a sage-grouse lek, up to 70 males may be present, standing as close as a few feet, or as far as 300 feet, from their nearest competitors. For prairie-chickens and sharp-tailed grouse, numbers are usually lower, with each lek hosting somewhere between eight and 40 displaying males. Males cluster along their territories' edges, facing off and often scuffling. During skirmishes, male sage-grouse buffet each other with their wings, but rarely peck or scratch at each other in midair like prairie-chickens and sharp-tailed grouse.

Male lekking grouse perform stereotyped and, to human eyes, outrageous breeding displays. Females appear to select the few top lekkers with the showiest plumage and most vigorous struts. Once females make their choices, mating lasts but a few seconds. A male may mate more than 20 times in a morning, changing mates every two minutes. One sage-grouse male in Montana was observed mating 169 times in one breeding season.

All of the strutting, jumping, stomping, hooting, popping, and fanning ends in results males do not quickly see. After the dominant males are chosen by females and mating occurs, the females leave the leks and prepare to nest. Males do not aid in nest-building, incubation, or feeding the young.

No one knows for sure how much longer these rituals will continue. Once common across wide-open wilderness expanses, lekking grouse are all losing ground to human-caused landscape changes and other forces.

"Chickens" of the Prairie

There are three species of prairie grouse, and all belong to the genus *Tympanuchus*: the greater and lesser prairie chickens, and the sharp-tailed grouse.

Barred in dark brown, cinnamon, and buff, prairie-chickens resemble, in size and general shape, striped poultry. They certainly filled many a Native American and prairie settler's cooking pot. The greater prairie-chicken (*T. cupido*) inhabits tall-grass prairie, and one subspecies—the heath hen (*T. cupido cupido*)—was found in open grassy parts of the Northeast until 1932, when the last disappeared from Martha's Vineyard, Massachusetts. The lesser prairie-chicken (*T. pallidicinctus*) lives in semi-arid shortgrass prairie, now mainly in a distribution resembling a fading crescent that runs from the far western corners of Kansas and Oklahoma to extreme eastern Colorado and New Mexico, then south to the Texas Panhandle.

Ronald L. Westemeier, a retired biologist and prairie-chicken expert, has studied and worked to protect isolated greater prairie-chicken populations at the current eastern terminus of their range in Illinois. After more than 30 years of study, he still raves about the birds' activities. "It's quite a spectacle. They do their breeding displays on a communal grounds that requires wide open spaces. Bare ground is the best," he says. The lekking spectacle, called "booming" in prairie-chickens, picks up momentum in March, when the normally drab, furtive birds first step out into the open. It peaks by mid-April, peters out by May.

"If the females come in, the males get all excited," says Westemeier. "But probably only ten percent of males are involved in actual copulations." When prairie-chicken competitions are in full swing, the males display in a frenzy. With lowered heads and raised tails, they inflate brightly colored, bubble-like sacs on the sides of their throats, and raise dark feathers on their heads that resemble rabbit ears or, as the greater prairie-chicken's species name, *cupido*, suggests, the wings of Cupid. They rapidly stomp their feet while emitting moaning or gobbling calls; rivals hop at each other and may also leap into the air, making cackling sounds. The moan, or hoot, of the greater prairie-chicken can carry more than two-and-a-half miles across the birds' open habitat.

The most adaptable, and least rare, prairie grouse is the sharp-tailed grouse (*T. phasianellus*), revered and sought by hunters from Wisconsin to eastern Alaska. Although their traditional habitats include steppes, grassland, and open shrubby areas, sharptails now often occur in farm fields, and will even lek there on slight rises where there is little vegetation.

The sharp-tailed grouse is not only loved for its explosive flight and lean, gamey breast meat: People adore its showy lek antics, too. In fact, the town of Ashern, Manitoba, where rodeos, hunting, and fishing are among the most popular recreational activities, hails itself as "The Land of the Sharptail Grouse." Its most remarkable landmark is a 20-plus-foot-tall statue of the region's most sought-after fowl.

Sharp-tailed grouse sport elongated central tail feathers. To exhibit these showpieces to full advantage, males duck their heads and spread and lower their wings, and point their tails skyward like white-and-tan arrowheads. They cackle, coo, whine, bark, gobble, and make popping sounds with the air sacs. They face off, rattle their tail feathers, and quickly stomp their feet during their fervent dance displays, increasing the pace when females show up to watch. The lek may turn violent when males tug at competitors' feathers or attack them with their beaks, wings, or nails.

Grouse of the Sage

The largest grouse in North America is the greater sage-grouse, followed closely by the Gunnison sage-grouse. These two species are on average about 24 inches long, as opposed to *Tympanuchus* grouse's 15-to-17-inch length, and are more visually stunning. They puff out immaculate white breast feathers punctuated by two large yellow air sacs in the middle of their chests. They strut around with wings held low and blackish tail feathers splayed and pointed up like spiked turkey tails.

"Sage-grouse are slow-steppers and they never hop into the air like prairie-chickens," says Jessica Young, associate professor of biology at Western State College of Colorado in Gunnison. "In addition, they don't have drumming feet and their air sacs are much lower on the front of their bodies, part of the esophageal pouch, or chest. They pop their air sacs instead of hooting like the prairie-chickens, and their tails are held upright throughout their strut display." The bubbly popping sounds are generated when the air sacs quickly deflate.

Young is an expert on the Gunnison sage-grouse (*Centrocercus minimus*), a species split by taxonomists from the more widespread greater sage-grouse (*C. urophasianus*) in 2000. Gunnison sage-grouse, which now live only in western Colorado and eastern Utah, reach only two-thirds the size of greaters, and their plumage and lekking activities differ in some ways. "They throw their neck feathers, or filoplumes, over their heads," says Young, "and typically end their strut by shaking their tails." There are differences in the sounds they make as well. The Gunnison display occurs at a slower speed, with more air-sac pops per strut than in greater sage-grouse.

A prairie-chicken displaying.

Robert E. Mumford, Jr./Natural Images Photography

Something to Grouse About

The time to take conservation action to save all the lekking grouse is now. All five North American lekking grouse have suffered serious declines over the past 150 years, with some of the most rapid changes occurring over the last few decades. Both the lesser prairie-chicken and Gunnison sage-grouse, for example, have been candidates for listing under the Endangered Species Act. In April 2006, however, the U.S. Fish & Wildlife Service (USFWS) refused to list the Gunnison sage-grouse and dropped it as a candidate, in part due to disagreement over the degree of decline the species has undergone in recent decades. Meanwhile, also in 2006, the National Audubon Society declared this bird one of the ten most endangered in North America. The Gunnison's habitat has been reduced to less than nine percent of its original extent, and the remaining populations total perhaps 4,000 to 6,000 birds in the spring, when researchers count them and before nesting begins.

As few as 20,000 lesser prairie-chickens remain, in former Dust Bowl areas. Numbers are down more than 90 percent since the 1960s, with a majority of birds in Kansas and New Mexico, and lower numbers in Texas, Oklahoma, and eastern Colorado. The species is the focus of a new joint effort between the USFWS and the Texas Parks & Wildlife Department to recruit private landowners to voluntarily protect the birds and their grassland habitat. For their efforts, participating landowners will not face any land-use restrictions or conditions if the bird is federally listed. In 1998, the USFWS decided that, due to substantial declines throughout its five-state range, the species designation under the Endangered Species Act would be justified, but the designation was not made after a finding that listing was "warranted but precluded." A 1998 USFWS press release read: "Protection of the lesser prairie-chicken under the Federal Endangered Species Act is justified but other species in greater need of protection must take priority in the listing process. . . ." It has been a listing candidate ever since.

The largest remaining greater prairie-chicken populations are found in parts of Kansas, Nebraska, and South Dakota, with smaller numbers in North Dakota, Minnesota, and other Plains states. Many small satellite populations, like those in Illinois, face uncertain prospects. Yet even in places with the largest populations, such as in the Flint Hills region of eastern Kansas and northern Oklahoma, recent trends in cattle ranching that include early spring burning and intensified stocking of pastures may be contributing to steady population declines. Conservationists recommend lessening grazing pressure and providing more of a mosaic of tall and short grasses to ensure a healthy coexistence between cattle and grassland wildlife in this region.

Jeff Vanuga/naturepl.com

Male sharp-tailed grouse square off for females' attention.

Prairie-chickens sometimes descend upon soybean, milo, and other agricultural fields in late fall and winter in large flocks, but while grain in these fields provides important food at times of shortage, farmlands constitute only a small percentage of prairie-chicken habitat, most of which must remain in grassland for populations to survive.

When first described in 1805 by the Lewis and Clark expedition, the greater sage-grouse was common and widespread across much of the West. Since then, and especially since the 1950s, populations throughout the bird's range have declined. Today, about half of the greater sage-grouse's sagebrush habitat has been lost to overgrazing, development, gas and oil exploration, and road-building. In areas that remain, the bird's presence says much about how well its habitat is faring. "I would call the sage-grouse a wonderful indicator species of sagebrush and shrub-steppe ecosystems," says Young. Sage leaves and buds constitute an important part of the bird's diet, especially in fall and winter, and it does best in heterogeneous sagebrush habitats that include dense, sparse, old, and young patches of vegetation.

Yet even where ideal habitat remains, changes may soon be underway. A 2005 Oregon State University and U.S. Forest Service study predicted that sagebrush ecosystems may be cut to a fraction of their current size by climatic changes wrought by global warming. In addition, since 2006, greater sage-grouse deaths from West Nile virus have been reported in eight states, indicating that the disease's spread may be a further threat to these birds.

The sharp-tailed grouse has also declined in many of the southern and eastern parts of its range due to habitat alteration. It occupied 21 states and eight Canadian provinces but is now gone, for example, from California, Illinois, Kansas, Nevada, and Oregon.

The abundance of lekking grouse once seemed as unshakable as the plains and sagebrush ranges that stretched across the horizon. Ranchers, farmers, hunters, and birders still enjoy watching the early-morning spring rites of the lekking grouse that typify the wide-open range. But the performances play at fewer venues each year. Today, these birds seem to be riding an imaginary pendulum, one that could swing toward the heath hen and extinction, or toward an endless continuation of the "sex play" upon which these species depend for survival. Z

—*Contributing editor Howard Youth's last* ZooGoer *article focused on Asia's clouded leopards.*

To see lekking grouse in action, visit this story online at **www.fonz.org/zoogoer.htm.**

A Woman's Place

Chrysalis: Maria Sibylla Merian and the Secrets of Metamorphosis
Kim Todd. 2007. Harcourt, Inc., New York. 328 pp., hardbound. $27.

As a toddler, Maria Sibylla Merian had an "odd and dirty interest in insects." Born in 1647 in Frankfurt, Merian lived in the midst of the scientific revolution in Europe, when people were beginning to look at the world differently and more closely, and to ask questions about what they saw.

In the realm of biology, this was a heady time. European explorers were discovering the people, plants, and animals of previously unknown worlds. The first use of a microscope revealed a new world of small creatures and small parts of bigger ones. It was the dawn of embryology, as people tried to show how an egg developed into a chicken. Thinkers were doing the first experiments—a new word—to find out whether insects and other "lowly" animals really arose through spontaneous generation. And it was recognized for the first time that the various stages of an insect's life—egg, larva, pupa, and adult—were different forms of the same individual, not different animals altogether.

The names of the men who led this revolution in biology are at least vaguely familiar to anyone who took high-school biology: Robert Hooke (father of modern science), Jan Swammerdam (father of entomology), Antony van Leeuwenhoek (father of microbiology), Marcello Malphigi (father of comparative physiology and microscopic anatomy), and Francesco Redi (father of biological experimentation) were leading lights still remembered for their contributions.

However, Merian, their contemporary, doesn't appear in textbooks, although she was once as well-known as these men and is arguably the mother of ecology and of scientific illustration. Unarguably, Merian was a remarkable woman who escaped the confines most of her sex lived within in a male-dominated society to become the first person (not just the first woman) to undertake "a purely scientific journey to do field research in a foreign country."

Growing up in and later marrying into families of artists, engravers, and printers gave Merian unusual freedom to learn to paint (in watercolors—women were forbidden to paint in oils) and unusual access to books and conversations about the new scientific ideas swirling around Europe's intellectual capitals. Inspired by new ideas about insects and metamorphosis, for years she documented and painted the life stages of moths and butterflies in the gardens and backyards of her various homes. She brought larvae into her kitchen, carefully tending them until they pupated and emerged as adults, so she could match caterpillar to butterfly. But she never lost sight of the insects' natural habitat.

In 1679, she published her first major work: *The Caterpillar's Wondrous Metamorphosis and Particular Nourishment from Flowers... through a completely new invention the origin, food and development of caterpillars... and other such creatures, including their times and characteristics are diligently studied, briefly described from nature, painted, engraved....*

Merian's entirely new invention was to show insects as members of a community. Caterpillars rested on the plants they ate. Pupae, cocoons, and adults appeared on the same page. Adults were shown laying eggs on a plant, which bore telltale signs of caterpillar bites. Predators were sometimes included. This had simply never been done before. Her book was widely acclaimed and for the next 20 years, Merian continued to study and paint insect life histories.

Then, in 1699, at the age of 52, Merian journeyed, alone but for her young daughter, from Amsterdam to Surinam with the express purpose of studying and illustrating its insects and plants. For two years, she explored Surinam's flora and fauna, working in her garden as well as deep in the rainforest. Realizing that much of the rainforest diversity was out of reach in the trees, she climbed ladders to see it and had trees chopped down when a ladder wasn't enough, foreshadowing modern efforts to study life in the rainforest canopy.

Returning to Amsterdam, she spent five years preparing her monumental *Metamorphosis Insectorum Surinamensium*, published in 1705. Again, she depicted insects in their ecological settings, made more marvelous by the novelty of the new plants and animals she described. She was the first, for instance, to describe and paint a bird-eating spider with a bird in its web. This book sealed her reputation as a leading natural historian, and throughout the 1700s she was cited regularly in the scientific literature. In the 1800s, though, she fell out of favor and her work was dismissed. By the 1900s, she was forgotten.

In *Chrysalis*, Kim Todd attempts to bring Merian back into the limelight. Part biography, part social history, part history of science, *Chrysalis* paints a beautiful portrait of Merian's life and work, convincing me that this amazing woman has a rightful place in the pantheon of the founders of biology.

—*Susan Lumpkin*

Visit this review online at **www.fonz.org/zoogoer.htm** for links to Merian's images.

by Shannon Lyons

Stolen Tears

There's no accounting for taste, but scientists think a Madagascan moth that sips the tears of sleeping birds might be looking for salt. The *Hemiceratoides hieroglyphica* moth sits on the necks of snoozing magpie robins (*Copsychus albospecularis*) and Newtonia birds (*Newtonia brunneicauda*). The moth uses its nearly half-inch-long proboscis, which is barbed like a harpoon, to penetrate two layers covering the birds' eyes: the upper and lower outer eyelids, and the inner nictitating membrane. It may also use a natural anesthesia to reduce irritation during the procedure, enabling it to drink for as long as 35 minutes without waking its host. Other moths and some butterflies drink the tears of mammals such as elephants and reptiles such as crocodiles, but this is the first moth known to drink from birds. Roland Hilgartner of the University of Ulm in Baden-Württemberg, Germany, and his colleagues published their discovery of the moth's strange behavior in the December 2006 issue of *Biology Letters*.

What's in a Name?

Raptors are carnivorous birds with sharp eyesight, hooked beaks, and strong, grasping feet with sharp talons. It's no surprise that the word "raptor" is a derivation of the Latin *rapere*, meaning "to seize or snatch"; it's an apt description of how these birds pluck their prey from land, water, or air.

Raptors' common names often reflect their appearance or behavior. "Falcon" comes from the Latin root *falx*, meaning sickle, a reference either to the shape of falcons' beaks or their silhouettes in flight. "Tiercel" is a term used for male falcons and hawks and can be traced to the Latin word *tertius*, meaning "third"; males of these species are often one-third the size of females. And "kestrel" comes from the French word *crecelle*, meaning "rattle," after the sound of the kestrel's cry.

The eagle splayed across the Seal of the President of the United States demonstrates how raptors have influenced the English language. Its wings and limbs are akimbo, or "spread-eagle," an adjective also applied to exaggerated boasts of our country's greatness. Keen-sighted people are called "eagle-eyed" or "hawkeyed." A person's long, hooked nose is "aquiline," which comes from *aquila*, the Latin word for eagle. And a "haggard" person's wild appearance might bring to mind a *hagard*, the Middle French word for an untamed hawk.

Komodo dragons are the world's largest lizards; the largest recorded specimens exceeded 300 pounds and ten feet in length.

In Season

Sexually mature American shad (*Alosa sapidissima*) begin their springtime migration when the water in mid-Atlantic rivers reaches about 55°F. Leaving the salty environs of the Chesapeake Bay or the ocean, they travel far upstream to their freshwater spawning grounds. Females release massive quantities of eggs, and those that are fertilized and survive predation hatch into fry within three weeks. Juveniles remain in fresh water until autumn, when cooling temperatures trigger their instinct to swim to the ocean. American shad was once the largest fishery in the mid-Atlantic, but by the early 20th century overharvesting, dam-building, and pollution had greatly reduced the overall population.

Why Do Animals Sunbathe?

For humans, lounging in the sun makes for a relaxing afternoon. But for ectotherms–insects, reptiles, and other animals whose body temperatures vary with the ambient temperature–it's a survival skill. For example, butterflies can't fly when they're cold, so they open their wings like solar panels to gather the sun's heat before takeoff. Sunshine also facilitates digestion in reptiles and the production of vitamin D in many species, including humans. Birds sunbathe too. After soaring, raptors may warm their plumage in the sun to reshape feathers bent by air currents. And violet-green sparrows (*Tachycineta thalassina*) seem to sunbathe to make their feathers too hot for mites and other parasites. But their self-induced fever has a downside: Sometimes they get so overheated that they fall over in a stupor.

Fact or Fiction: Males Can't Get Pregnant

There's an exception to almost every rule, including the one that says pregnancy is the exclusive domain of females. In the family Sygnathidae, male seahorses and some pipefish make like mamas and carry their unborn offspring on their bellies. For seahorses it all begins with a showy courtship dance. Afterward, the female uses a tubular organ called an ovipositor to transfer hundreds or even thousands of eggs into a pouch on her mate's abdomen. The male fertilizes the eggs, and liquid in his pouch nourishes the developing embryos for several weeks. Contractions and labor signal the end of the pregnancy, followed by the emergence of fully formed baby seahorses.

Newtonia bird and moth: Roland Hilgartner/www.rolandhilgartner.com. Bald eagle: Dave Menke/USFWS. Komodo dragon: Norman Owen Tomalin/Bruce Coleman Inc. Golden seahorse (*Hippocampus kuda*): Jane Burton/Bruce Coleman Inc.

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